FIELD OF THE INVENTION

The present invention relates to a shed forming mechanism and to a weaving loom equipped with such a mechanism.

BACKGROUND OF THE INVENTION

In a Jacquard type weaving loom, a shed forming mechanism selectively lifts heddles, each comprising an eye in which a warp yarn passes, this yarn being located, as a function of the position of a hook to which the upper end of the heddle is fixed, above or below a weft yarn displaced by the loom. Such a known mechanism, for example disclosed by EP-A-0 219 437, comprises, *inter alia*, mobile hooks each provided with a lateral catch capable of cooperating with knives animated by vertical reciprocating movements in phase opposition. Each mobile hook is provided with a curved end allowing it to be immobilized by cooperation of shapes with a retaining lever.

Each mobile hook is also provided with an elastic tongue in one piece with the hook and intended to control the displacement of the retaining lever. Such a tongue is subjected to repeated, relatively intense efforts likely to induce permanent deformation by creeping, and even rupture thereof. In that case, the shed obtained presents "faults".

It is a particular object of the present invention to overcome these drawbacks by proposing a shed forming mechanism of which the mobile hooks are robust and dimensioned precisely, this ensuring reliable operation of the loom, while they are compact in height, i.e. parallel to their direction of displacement. This makes it possible to create a compact mechanism, hence a saving of space and improved economic performances.

SUMMARY OF THE INVENTION

To that end, the invention relates to a shed forming mechanism on a weaving loom of Jacquard type, this mechanism comprising mobile hooks, each displaced by a knife, between a position of top dead centre, in or near which

each hook may be immobilized by a selection device, and a position of bottom dead centre, each mobile hook comprising a body provided with a catch, intended to come into abutment on the afore-mentioned knife. This mechanism is characterized in that each hook further comprises a metal blade intended to interact with the selection device and fixed on the said body, with the possibility of relative clearance with respect to the body, in a zone of this body opposite the selection device with respect to the zone of the body from which the catch extends.

Thanks to the invention, the two-part nature of the mobile hooks, of which the body is advantageously made of synthetic material, makes it possible to benefit from the robustness of the body for the mechanical link between the hook and the knife, while the geometry of the metal blade is defined with high precision, this rendering the interactions between the mobile hook and the selection device highly reliable. As the metal blade is fixed on the body in the lower part when the hook is in configuration of operation of the mechanism, the flexibility of the blade, over substantially the whole of its height, may be used for the transverse displacement of its part more particularly intended to come into engagement with a corresponding part of the selection device. The fact that a relative clearance is possible between the blade and the body of the hook may come from the suppleness of the blade and/or from that of the body.

According to advantageous, but non-obligatory aspects of the invention, this mechanism incorporates one or more of the characteristics of the dependent Claims.

In particular, the electromagnet of the selection device may be moulded in one of the sides of a box for receiving and for guiding in translation the mobile hook. Such moulding induces a precise positioning of the electromagnet with respect to the other functional parts of the device, such as the pins of the retaining levers, the stops and the bearings of these levers, as well as the grooves

for guiding the mobile hooks. Due to this high precision, the amplitudes of the movements of the mobile parts may be reduced, particularly concerning the oscillation of the retaining levers and the bending of the blade of the mobile hooks. This also contributes to the compactness of the mechanism.

The invention also relates to a weaving loom equipped with a shed forming mechanism as described hereinabove.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more readily understood and other advantages thereof will appear more clearly on reading the following description of three forms of embodiment of a shed forming mechanism in accordance with its principle, given solely by way of example and made with reference to the accompanying drawings, in which:

Figure 1 schematically shows a weaving loom of Jacquard type incorporating the invention.

Figure 2 is a longitudinal section on a larger scale of the shed forming mechanism of the loom of Figure 1.

Figures 2A and 2B are partial sections respectively along lines A-A and B-B in Figure 2.

Figure 3 is a view on a larger scale of a mobile hook and a part of a retaining lever of the mechanism of Figure 2.

Figure 4 is a view in the direction of arrow IV in Figure 3.

Figure 5 is a view similar to Figure 2 for a mechanism in accordance with a second form of embodiment of the invention.

Figure 6 is a partial longitudinal section through a mechanism in accordance with a third form of embodiment, and

Figure 6A is a partial section along line A-A in Figure 6.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, Figure 1 shows a weaving loom M in which a lap of warp yarns 1 comes from a beam 2. Each warp yarn 1 passes in the eye 3a of a heddle 3 intended to open the shed to allow the passage of a pick with a view to constituting the fabric which is wound on a reel 4. Only two heddles 3 and 3' are shown in Figure 1, heddle 3 being in upper position, while heddle 3' is in lower position. The lower end of each heddle is connected to the frame of the weaving loom by an extension spring 5, while its upper end is fast with harness cords 6.

A shed forming mechanism 7 associated with an electronic control unit 8 makes it possible to lift the harness cords 6 more or less against a return effort exerted by the springs 5. As shown solely for the harness cord associated with the heddle 3, each harness cord has one end 6a fast with a box 10 of the mechanism 7, this harness cord passing in a pulley block 11 suspended from a cord 12 of which the two ends are respectively fast with two mobile hooks 13 intended to be selectively lifted by knives 14 animated by a vertical oscillatory movement in phase opposition, as represented by arrows F_2.

Only a part of the elements constituting the shed forming mechanism has been shown in Figure 1 in order to render the drawing clearer.

As is more particularly visible in Figures 2 to 4, each hook 13 is formed by a body 20 of plastics material, in the lower end 201 of which is moulded an end 12a of the cord 12.

The body 20 forms a single catch 202 which extends laterally with respect to a principal longitudinal axis X-X' of the body 20. This catch 202 is intended to come into abutment on the upper surface 14a of a knife 14. The hook 13 may thus be regularly lifted by a single knife 14.

Taking into account its constituent material, the body 20 presents a certain suppleness, allowing it to adapt itself to a possible defect of position or of

parallelism of the respective paths of this body and of the knife 14 associated therewith. This possibility of elastic deformation of the body 20 is represented by the double arrow F_{20} in Figure 2. In practice, the suppleness of the body 20 makes it possible to obtain a self-positioning of the catch 202 on the knife 14.

The hook 13 also comprises a metallic blade 21 partially moulded in the body 20. In practice, the blade 21 comprises a part 211 moulded in a zone 203 of the body 20, located near its lower end 201, i.e. below the part 204 of the body 20 from which the catch 202 extends laterally.

The part 211 is open downwardly, this allowing the passage of the end 12a of the cord 12 which may therefore be moulded in the body 20 over a relatively great length L_{12}.

The blade 21 extends over a length L_{21} above its part 211, this length being relatively great with respect to the total length L'_{21} of the blade 21.

The blade 21 comprises two lateral uprights 212 and 212' defining therebetween a window 213 in which is housed the major part of the body 20.

The uprights 212 and 212' extend beyond the window 213 as far as a curved end 214. The uprights 212 and 212' are connected by a crosspiece 215 which separates the window 213 from an opening 216 made between parts 212, 212', 214 and 215 of the blade 21.

Taking into account their respective mode of fixation, the elements 20 and 21 are fast in the lower part of the hook 13, while that part of the blade 21 which extends over the length L_{21} above the zone 203 of the body 20, is capable of lateral clearances, as represented by the double arrow F_3 in Figure 3. These lateral clearances F_3 correspond, in fact, to a relative clearance of the blade 21 with respect to the body 20.

The mechanism 7 also comprises an electromagnet 15 moulded in a part of the box 10. This moulding ensures a precise positioning of the electromagnet 15 with respect to the box 10 and to the elements that it supports or guides.

The box 10 comprises two fixed pins 10a on which are pivotally mounted two retaining levers 16 intended to cooperate respectively with the two mobile hooks 13 connected to the two ends of the same cord 12.

Each lever 16 comprises a metallic armature 30 provided with a cylindrical bore 301 of circular cross-section adapted to the outer diameter of a pin 10a, with the result that the armature 30 may be mounted about a pin 10a with the possibility of pivoting, as represented by the double arrows F_4 in Figure 2. The bore 301 of each armature 30 is made in an end 302 of this armature.

At its opposite end 303, the armature 30 is moulded in a body 31 made of an amagnetic material, such as synthetic material and, more specifically, a plastics material. The body 31 forms a catch 311 for retaining a mobile hook 13 in the vicinity of its position of top dead centre. The body 31 is also provided with a heel 312 for centring with respect to a spring 32 exerting on the body 31 an effort F_5 tending to cause the lever 16 to pivot towards the outside of the box 10. This effort tends to cause the catch 311 to penetrate in the opening 216 of the blade 21 of an adjacent mobile hook, which makes it possible to retain such a mobile hook in upper position.

The metallic armature 30 of a lever 16 makes it possible to control its pivoting thanks to the electromagnet 15, a lever 16 being able to be displaced by the curved end 214 of a blade 21 and possibly maintained in position against the effort F_5 when the electromagnet 15 is activated.

The body 31 allows an efficient interaction, without metal/metal contact, of a retaining lever 16 with a mobile hook 13.

The levers 16 are each provided with a deflector 161 projecting with respect to their principal part 16a in the direction of the median axis X_{10}-X'_{10} of the box 10, between its pivot axis 10a and a zone Z_1 in which the armature 30 can come into abutment against the electromagnet 15. A second deflector 162 is provided between the zone Z_1 and the adjacent hook 13. The deflectors 161 and

162 are mobile with the lever 16, inside grooves 101 and 102 made in the body 10, which allows them to isolate the zone Z_1 which thus forms a closed chamber protected against pollution, particularly the flock likely to be transported by a hook 13.

Taking into account the positioning of the pins 10a on the box 10 and the geometry of the levers 16, these levers extend solely downwardly from these fixed pins, which gives the mechanism 7 an improved compactness with respect to the mechanisms in which the lever extends on either side of its pivot axis, as described for example in EP-A-0 219 437.

Furthermore, the uprights 212 and 212' of the blade 21 of a hook 13 slide in grooves 10b made over the height of the box 10, as shown in Figure 2 where the cords 12 have been shown partially so that the grooves 10b are visible. In this way, guiding of a lever 13 with respect to the box 10 is effected precisely and with minimum wear. As is shown in Figures 2A and 2B, each groove 10b of the box 10 is defined by two ribs 10f and 10f' between which it extends, this allowing an efficient guiding of the upright 212 or 212' that it receives. Each rib presents this shape of the bottom of the box 10 approximately as far as the location of the upper convex part of the catch 202 to the right in Figure 2 where the rib 10f' is eliminated, while the rib 10f extends upwardly. The elimination of the outer edge 10f' of the groove, i.e. the fact that it is open towards the outside of the box in the vicinity of the retaining lever 16, allows the outward clearance of the blade 21, in the direction of arrow F_7 in Figure 2B, when the blade 21 comes into abutment against the adjacent lever 16, as shown to the left in Figure 2, in order to exert an effort of levelling F_6.

In practice, the essential of the bending of the blade 21 takes place at the level of that part of the box 10 where the groove 10b has no outer edge, this part extending over a height H, between the position of the top of the catch 202 to

the right in Figure 2 and the zone of interaction between the blade 21 and the lever 16 during levelling.

According to a variant of the invention (not shown), it is possible for the rib 10f' which forms the outer edge of the groove 10b not to be eliminated over the height H but to deviate from the rib 10f in order to leave the blade 21 a sufficient clearance space.

In the form of embodiment shown and in the afore-mentioned variant, the widening or opening of the groove 10b towards the outside in the vicinity of the elements 15 and 16 aims at allowing the bending of the blade 21 in this zone.

In accordance with the technical teaching of FR-A-2 752 246, a stop 40 elastically loaded by a spring 41 is mounted, between the paths of slide of two mobile hooks 13, in abutment on studs 10c of the box 10. This elastic stop 40 is intended to cooperate with a heel 205 made in the vicinity of the end 201 of each body 20. Taking into account the respective positioning of the elements 205 and 40, this interaction takes place when each mobile hook 13 arrives in the vicinity of its position of top dead centre. This arrangement makes it possible to overcome the essential of the forces of inertia and of friction of the mobile hooks, this facilitating reversal of movement and allowing the dimensioning of the harness and the mechanical parts for drive, such as the knives 14, or for elastic return, such as the springs 5, to be optimalized.

The curved end 214 of the blade 21 is also dimensioned so that it can come into abutment and exert an effort F_6 against a ramp 313 formed by the body 31 of each lever 16. This momentary abutment of a hook 13 on a lever 16 allows the lever 16 to be levelled, i.e. made to abut on the electromagnet 15, with elastic pre-loading due to the bending of the blade 21 which performs the function of the elastic tongue described in EP-A-0 219 437. The blade 21 therefore performs a function of levelling.

In the second form of embodiment of the invention shown in Figure 5, elements similar to those of the first embodiment bear identical references. As previously, knives 14 make it possible selectively to displace mobile hooks 13 each comprising a body 20 made of synthetic material and an elastic metal blade 21 which essentially extends above the zone where it is fixed to this body. Retaining levers 16 are associated with an electromagnet 15.

In this form of embodiment, the levers 16 are mounted to pivot about pins 10a fixed with respect to a box 10. The technical teaching of EP-A-0 577 524 is applied here, insofar as the box 10 comprises partitions 10d making it possible to isolate the electromagnet 15 from the ambient atmosphere. Each lever 16 is mounted to pivot on the corresponding pin 10a, as represented by the double arrow F_4 and comprises an armature 30 which extends on either side of the pin 10a on which it is mounted. More precisely, each armature 30 comprises a first arm 304 which extends upwardly from a central part 305 in which is made a circular bore 301 for receiving the pin 10a. The arm 304 is intended to interact with the electromagnet 15 as a function of its activation. The armature 30 also comprises an arm 306 which extends opposite the arm 304 with respect to the part 305. This arm 306 is moulded in a body 31 made of plastics material which forms a catch 311 intended to interact with an opening 216 of the blade 21 of a hook 13. The body 31 also forms a ramp 313 for levelling the position of the lever 16 used during an interaction with the curved upper end 214 of a blade 21. The blade 21 in that case exerts on the lever 16 an effort F_6 of displacement of the armature 30 towards the electromagnet 15.

In order to isolate the electromagnet 15 efficiently, the partitions 10d of the box 10 are provided with O-rings 10e disposed in the vicinity of the outer surface 305a, cylindrical with circular base, of the part 305. In this way, independently of the orientation of a lever 16 about the axis 10a, a satisfactory seal can be ensured.

In a variant embodiment, the partitions 10d may be provided with reduced clearance with respect to the surface 305a, the seals 10e in that case being able to be eliminated, as the ends of the partitions 10d then constitute means for seal against dust.

In the third form of embodiment shown in Figure 6, elements similar to those of the first embodiment bear identical references. As previously, hooks 13 each comprise a body 20 made of plastics material as well as a metal blade 21, these elements being moulded in one another in the lower part of the body 20. A movement of relative clearance F_3 is possible between the body 20 and the blade 21 of each hook. The blade 21 of each hook may be retained in position by a catch 311 formed by a body 31 of a retaining lever 16 mounted to pivot about a pin 10a formed by a box 10.

Each lever 16 comprises a metal armature 30 intended to interact with an electromagnet 15 at the level of a zone Z_1 in which the armature 30 may come into abutment against the electromagnet 15 against an elastic effort exerted by a spring 32 centred on a heel 312 of the body 31.

As in the first form of embodiment, a deflector 161 is provided on each lever 16, between the armature 30 and the pin 10a while a second deflector 162 is provided between the armature 30 and that part of the body 31 intended to interact with the blade 21 of a hook 13. The deflector 162 of this third embodiment may move inside a groove 102 made in the box 10 between the positions respectively shown to the left and to the right of Figure 6. This deflector 162 projects with respect to the principal part 16a of the lever 16 both in the direction of the median axis X_{10}-X'_{10} of the box 10 and opposed thereto, with the result that the circulation of flock or of dust is prevented both between the lever 16 and the electromagnet 15 and between the lever 16 and the outer web 10g of the box 10.

In addition, and as is more particularly visible in Figure 6A, the deflector 162 also projects perpendicularly to the plane of Figure 6 with respect to the principal part 16a of the lever 16, this also avoiding pollution rising in the direction of the armature 30.

Whatever the form of embodiment in question, the elastic blade 21 efficiently performs the functions of selection and of levelling, while it is not in contact with the adjacent knife 14, the function of direct interaction with the knife devolving on the catch 202 of the body 20. In the same way, the body 20, through which the effort of traction exerted by the knife 14 transits, does not enter directly into contact with the selection device which comprises the elements 15 and 16.

The characteristics of the different forms of embodiment described may be combined within the framework of the present invention.

The invention relates to two-position shed forming mechanisms used for weaving so-called "flat" fabrics, unlike three-position mechanisms used for carpets and velvets. However, the invention can be used within the scope of associating two-position mechanisms allowing a three- or four-position shed to be obtained, as described for example in EP-B-0 399 930 or FR-B-2 715 666.